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An Economic Analysis of Land Values in the Nebraska Rainwater Basin Using Hedonic Pricing

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AN ECONOMIC ANALYSIS OF LAND VALUES IN THE NEBRASKA RAINWATER BASIN USING HEDONIC PRICING

By

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Environmental Studies – Natural Resources Emphasis

Natural Resource and Environmental Economics

Abstract

This project was designed to determine the significant drivers of land prices near wetlands, with the goal of offering recommendations to landowners that may be trying to choose the best option for their wetland. This process included measuring whether or not the presence of wetlands reduced property values in a section of Seward County within the Nebraska Rainwater Basin. To accomplish this, I use the hedonic pricing method with statistical regression analysis. The results indicate that although there is a bias against wetlands, it accounts for less than half of the change in sale price within these parcels of land. The reason for this is because the single most important driver of property value is the amount of irrigated acres for a parcel of land. The amount of dry and grassland acres showed a negative effect on property value relative to irrigated land, which indicates the high value of irrigated land. Although there is a strong enough market for agricultural products to make it seem more economically feasible to fill wetlands rather than conserve them, it is possible to do so without forgoing all potential profit. This study explores Wetland Mitigation Banking and Conservation Easements as potential alternatives for landowners.

Preface

I would like to thank Dr. Karina Schoengold for being my advisor throughout this research and Dr. Gary Lynne for assisting me with this project. I would also like to thank the Nebraska Game and Parks Commission, the United Sates Environmental Protection Agency, the Nebraska Library Commission, the Nebraska Department of Environmental Quality, and the Nebraska Land Trust for providing me with valuable information to aid me in this research. I would also like to thank Dr. Sara Cooper and Dr. Dave Gosselin for giving me guidance over the duration of this study.

Introduction

Although average land prices in Nebraska have been rapidly increasing for the last decade due to their value for agricultural uses, there is significant variation in sale prices, and the trend of rapidly increasing land prices is starting to subside. Any landowner making choices about land sales or development is interested in understanding the variables that affect property values. There are many factors that affect the value of land, including soil type and proximity to a city or town. One factor that may affect land values is the presence of wetlands (Johnson, 2012).

Now that the Nebraska land market trends are levelling off more wetland owners may wonder how to better highlight the non-agricultural qualities that their land may have, and may even choose not to sell if the wetland provides critical biological services. This is at the heart of a long-running debate between environmentalists, wetland owners, and developers.

Environmentalists argue that wetlands need to be preserved as much as possible because of the important roles that they play in the health of the ecosystem, such as wildlife habitats. However, many owners have argued that it isn't fair that they should have to pay the opportunity cost of the potential production value that their land may have so that the rest of the world will benefit from the services. Why should they have to pay for something that is shared by everyone?

The solutions to this problem that environmentalists have proposed have mostly been concerned with quantifying biological service values to provide a comparison to potential production values. In order to give these service values some actual market value, conservationists have developed methods – such as conservation easements and wetland mitigation banking – that provide wetland owners with the opportunity to receive a fair return on their property without having to produce commodities on it.

The purpose of this project is to provide evidence that measures whether or not the presence of wetlands reduces property values in the Nebraska Rainwater Basin, and to identify which other variables are the most significant drivers of land prices. To accomplish this, I use the hedonic pricing method with statistical regression analysis. In this way I am able to determine if proximity to a wetland affects land prices, and I am also able to determine if any of the available property assessment or sales data could be correlated to land prices. Given the limitations in this data, the variables I use are: location, land use type, and parcel size. Other possible variables that may account for changes in sale values (e.g. topography, health of the landowner, financial situation for buyers and sellers) could not be included in the models because they could not be verified or quantified.

Why should wetlands be conserved?

Water is an essential resource for all life on Earth. The various waterways and water bodies determine the location, shape and population of every terrestrial habitat. The protection of this vital resource in all of its forms is one of the most important challenges, as it is crucial to sustaining all life on the planet. Traditionally, one of the most undervalued forms of this resource is the wetland. The reason is that most wetlands offer little recreational value for humans, and the other services offered by them are easily overlooked or undervalued by potential landowners, thus there is no market for wetland services.

This is true around the globe as many places have experienced a decline in wetlands in the last century. For example, in India "70 to 80 per cent of fresh water marshes and lakes in the gangetic flood plains have been lost during the last 50 years" and two-thirds of what is left is "under paddy cultivation" (Wetlands at, 2011). Again, the problem here is that the biological services offered by the wetlands have little value compared to production. Even if it might be possible to conserve the wetland and get a reasonable return from an easement, often the temptation to get a much greater return by selling it to someone who intends to fill it and produce on it is irresistible.

In the United States, the value of wetlands is highlighted by federal conservation programs, and steps have been taken to attempt to protect the remaining wetlands from the many human activities which threaten water resources (Clean, 2012). Nonetheless, although there is protection of wetlands under the Clean Water Act of 1972 and a general federal policy of "no net loss of wetlands," there are still questions concerning the effectiveness of these protections, and there is still an ongoing debate between landowners and conservationists over the fair use of private lands. Federal policy may have highlighted the hidden values of wetlands, but too many original wetlands are still being filled. Perhaps the values of the services offered by these lands are not given a fair consideration compared to the values of development. This issue has been on the minds of environmentalists for many years and much work has been done to find answers to this problem.

An extensive holistic evaluation of the various ecosystem services and natural capital throughout the world has been done by noted professor and environmentalist Robert Costanza. Dr. Costanza and his colleagues catalogued 17 ecosystem services for 16 different biomes, which are estimated to value between 16 and 54 trillion dollars per year. In their study, they offer a detailed analysis of wetlands services as well.

They show that wetlands not only account for a portion of the services provided by all plant communities, such as greenhouse gas regulation of the atmosphere (which also effects climate regulation), and water flow regulation (which also effects disturbance regulation, ie flood prevention). They also have specific functions that are not found elsewhere, such as waste water treatment (which can eliminate alternatives that are very costly). In fact, the list of benefits from wetlands is quite extensive, including erosion control, nutrient cycling, and refuges for wildlife including – in Nebraska – a federally listed Endangered Species, the whooping crane, that all add to the value of these unique habitats (Costanza, et al. 1998).

Methods of Wetland Preservation

There are many environmental groups that are working to protect wetlands by assessing the value of the ecosystem services provided by wetlands. Others are using the results of these studies to provide information, counseling, and services to landowners who are struggling to assess their land. An example is the Agriculture and Food Research Initiative by the National Institute of Food and Agriculture who provide private landowners with resources that help them protect natural resources, preserve forest and range health, and improve water quality, in addition to many other services (Wetlands Management, 2014).

According to the report entitled, "The Economic Values of the World's Wetlands," by the Swiss Agency for the Environment, Forests and Landscape (SAEFL) in 2004, the value of wetland services in North America was $5,582 per acre. This assessment was determined by adding all of the individual values of the possible services that may be provided by wetlands (as determined by their global survey of bio-services values). So, a particular wetland may not have all of the services on the list and therefore, may not be worth this maximum amount. Still, this list of service values provides a quick and easy method for estimating the potential value for any wetland for which a list of services may be determined (Wetlands Management, 2014).

Looking at a sample of land sales in Nebraska over the last five years, I find that the average sale price is $5,098 per acre. When compared with the value given above for the average value of wetland services, it is clear that even with the recent increase in property values, it is possible that conserving wetland services may provide as much or even more value than selling land for agricultural production. However, this requires a mechanism for landowners to get a financial return based on those service values.

One method for a landowner to get a return on biological service values is by using wetland mitigation banking systems. This method involves restoring, creating, enhancing or preserving wetland areas for credits, and these credits can be sold to compensate for unavoidable wetland losses. The main objective in this policy is to ensure that wetlands that are lost are replaced with other wetlands with similar physical and biological functions, even if those functions are at a location which may be far removed from the wetlands which are being developed (Compensatory, 2013). The end result is that some owners of wetlands are able to preserve the natural state of the environment without forfeiting the potential production value of their land because another entity must pay them for the right to develop a wetland elsewhere.

Another common method used to preserve wetlands is the implementation of a conservation easement. According to Nebraska Land Trust, a conservation easement is, "a legal agreement between a landowner and a non-profit conservation organization or government agency that forever prohibits specified land uses that are not compatible with conservation goals" (Nebraska, 2014). This method is somewhat flexible in implementation; as a piece of land could be divided, allowing a portion of it to be developed as long as it doesn't reduce the conservation practices delineated in the easement. The goal of a conservation easement is to reimburse a landowner for any lost productivity from other development or production activities according to a fair market value at that time. In this way, the cost of preserving the resources is passed on to the public or donors to conservation agencies, who are the recipients of services provided by the wetlands.

While mitigation banking and conservation easements are available in Nebraska, applying for either one may be a difficult process. Mitigation banking in particular requires the satisfaction of a review team from multiple agencies, some of which include: the U.S. Army Corps of Engineers, the Environmental Protection Agency, the Game and Parks Commission, the Fish and Wildlife Service, the Natural Resource Conservation Service, and the Department of Environmental Quality. Still, landowners planning to put a wetland into production also have to go through a permitting process if they wish to receive federal farm program benefits (Guide, 2014).

In-spite of the difficulties, many landowners have chosen to conserve their wetlands instead of converting them to agricultural uses. According to the Nebraska Game and Parks Commission, the various entities that are working to conserve Nebraska's wetlands, "have acquired or in other ways protected approximately 50,000 acres of wetlands" (Guide, 2014). Although this is evidence that it is possible to preserve wetlands in Nebraska, it represents only 3% of the remaining wetlands in the state. Therefore, there are still opportunities for owners of wetlands to take part in the effort to conserve natural resources without losing out economically.

My Research and Analysis

This project was designed to provide important data on the significant drivers of land prices near wetlands, with the goal of providing recommendations to landowners that may be trying to choose the best option for their land. I chose the Nebraska Rainwater Basin as my sample area for this study because it provides habitats to migratory bird species, a benefit of international importance. Specifically, I chose Seward County in the Rainwater Basin area to conduct my research and analysis because it contains both state and federal wetlands, including the North Lake Basin Wildlife Management Area and Tamora Waterfowl Production Area respectively.

In order to determine if a bias exists either for or against wetlands in the determination of assessed and sale property values I use the hedonic pricing method. This is a method "used to estimate economic values for ecosystem or environmental services that directly affect market prices" (Ecosystem, 2014). In other words, it uses the changes in property values or property sales price to estimate the effect of different characteristics of the property. These estimations are done using statistical regression analysis, which calculates the effect of various independent variables on a single dependent variable, such as property values. To use this method, I first compiled a list of assessed property values to compare with real estate sale values in Seward County.

Materials and Methods

My data set consists of parcels of land within Seward County. These values were obtained from the county assessors' online GIS database. I use 100 different parcels with assessed land values and 24 parcels of land with sale prices from the last five years. The assessed land values in Seward County are determined solely by land use and soil type. Specifically, each type of soil is more valuable when irrigated than the same soil types in dry or grassland form. Since I use five years of property sale values, I adjust the prices by using the Consumer Price Index (CPI) to calculate the real sale value (as opposed to the nominal value). The difference between the real sale value and the nominal value is that the real sale value accounts for inflation, whereas, the nominal value does not. The assessed value data is adjusted to reflect an inferred sales price using the relationship between sale price and assessed value on known sales.

There are many other variables which could affect the sale values, such as vicinity to an urban environment, local amenities, and economic opportunities in the region. However, many of these variables are not available from any public data source. Therefore, the variables used in the regression analysis with sales prices are the same as those used in the assessed sale value. Recognizing that I cannot include all relevant variables, I expect that my regression model for real sale values will not account for the entire range of price variations, and so will have lower R-square values than the assessed values. I also calculate the value per acre for these different parcels to use for comparison. The variables that I include in these regressions are ***distance to the nearest wetland***, ***distance to the nearest urban environment***, ***acres of grassland***, ***acres of dry land***, and ***total acres***. I chose not to include *irrigated acres* in these regressions because the majority of the *total acres* were irrigated; therefore, the regression displayed indicators of multicollinearity. Another indicator of this is that the *total acres* and *total irrigated acres* were statistically similar.

Results

Table 1 in the appendix shows the results for the regression on assessed property values. This regression consisted of five independent variables that hypothetically accounted for the variations in assessed property values. The independent variables used were the same as those listed above minus the *distance to the nearest urban environment*, which was calculated only for the plots with real estate sale values. The R-square value for this regression was 0.96, which was somewhat expected, given that the variables determining these values are all known. The p-values for all of the land-use types were 0.0, again not surprising, considering that the assessed values were generated by simply totaling the various soil types, which were divided into the three land-use types. Using the coefficient for the *total acres* variable, I can predict that for every additional acre in a particular parcel, the value of the parcel will increase by $5,731.11. This value is consistent with the average sale price per acre of $5,098.00 for the 25 parcels with sales data.

I compare the sales values with the assessed values of each plot in the sales data and find an average inferred sale value of 88% of the assessed value for each parcel. These inferred sale values are used in the regression in Table 3. There, the coefficient for the *total acres* variable was $5,043.38, which is much closer to values from the actual markets.

Regarding the bias for or against wetlands, the p-value for the *distance to the nearest wetland* (0.39) on the assessed values regression did not show a statistically significant correlation, yet it did have a positive coefficient of $3,038.31 per mile away from the wetlands. While this does not allow for an accurate prediction of the amount of bias against wetlands, it does support the general hypothesis that wetlands reduce the assessed and sales values for land.

Even if the regression does not show a strong statistical correlation for this, the results are logical since the study area is rural and consists predominantly of agricultural production. The production possibilities nearer to wetlands are likely to have costs that are not found farther away. For example, the cost of draining and filling even a small section of a wetland to produce crops can have an effect on the amount people would be willing to pay for the land. Having wetlands also requires agricultural producers to adopt additional practices to be eligible for government programs like federal crop insurance and direct payments.

The results also show that the coefficient for *acres of grassland* is negative and shows a decrease in the assessed value of $4,550.02 per acre of grassland. This is consistent with the average difference between irrigated and grassland soils of the same type. At the same time, the coefficient for *acres of dryland* predicted a decrease of $1,247.70, which is fairly consistent with the difference between irrigated and dryland soils of the same type. These results are not that unexpected, given the method used by county land assessors to calculate property values, but they do help to assure confidence in the model.

Table 2 in the appendix shows the *total real estate sale* values. This regression also includes the five independent variables listed above. Among these variables, the only strong predictor of real estate sale value was *total acres.* Results show that an additional acre in the parcel size increases the sale price by an average of $5,046.98. This is well above the state average of $3,195.00 given in the 2014 Nebraska Farm Real Estate Market Survey, which is expected, as Seward County is in the eastern portion of the state, where property values are generally higher.

In regards to the bias against wetland property values, the p-values for this regression are also not significantly correlated, yet the coefficient for *distance to wetlands* indicated a large average decrease in value of $40,168.58 for each mile from the wetland. Although the poor p-value of 0.54 says that this prediction is not statistically significant, the large positive coefficient still supports my hypothesis regarding a wetland bias. When looking at the *distance to the nearest urban environment*, the p-value of 0.87 is high enough to practically accept the null hypothesis that this variable has no correlation to sale value. This is likely due to the agricultural aspect of the land in this area accounting for the majority of the property value. The reasons that urban buyers might be looking to purchase land, such as the potential residential characteristics, would not be present here. Therefore, the affect that those variables would have in the regression are negligible.

Conclusion

Through my research, I have discovered that little of the data provided on property and real estate values could be used to accurately predict land sale prices. Although there is an obvious correlation between land use types in assessed property values, these variables are poor predictors of sale prices because the amount of irrigated acres accounts for such a large percentage of total acres. Therefore, there is little affect from the other land use types. The one variable that does significantly determine sales price is the *total acres* (parcel size), which is expected. Running the regression using the average value per acre still results in *total acres* being the only significantly correlated variable, though, the coefficient predicts a decrease in sale value by $51.66 per acre for each acre added. This decrease can likely be accounted for by the standard discount for a larger purchase.

I did not find any significant evidence from the data to indicate a bias against wetlands as I had hypothesized, although the positive coefficients did point toward a possible bias. Perhaps a larger sample size would have given a more definitive answer, yet it seems that for most practical purposes, the existence of a wetland nearby is not a consideration for the average land buyer. This is not very surprising, given that the commonly known drivers of land prices in Nebraska are the commodity prices around the world (Johnson, 2012). That brings this discussion back to where it began, with the previously rapidly increasing land prices in Nebraska finally softening.

It is clear from my research that any biological services that may exist within any parcel of land in the rainwater basin are not being evaluated by the assessors of property values or by potential land buyers. The only consideration for the assessed value is soil type and how that land is being used. It is not clear, however, whether any of the actual sales might have included considerations of any special values that may be inherent to the nearby wetlands that could give or take away value from the parcel for sale. This would be determined on an individual sale basis, and depends on if the buyer has interest in wetland preservation, as the difficulties in converting the wetland to production would not be a benefit to the buyer otherwise.

Recommendations and Future Research

One recommendation that comes out of this research is for owners of wetlands in Nebraska to consider the existence of multiple biological services that can be provided by the land. If biological services are prevalent, then landowners should contact the Nebraska Game and Parks Commission or the Department of Environmental Quality to schedule an appointment to have an expert come and look at their land. They will be able to tell whether or not it would be worth it to start the process of getting the necessary permits to take part in a conservation easement or mitigation banking system. Even if they do not recommend this option, the Nebraska Game and Parks Commission or the Department of Environmental Quality may still at least provide valuable information on the characteristics of the land that could be beneficial in real estate negotiations.

Another recommendation for owners of wetlands is to utilize the habitat services in the context of ecotourism to offset some of the lost production value. This could be in the form of hunting grounds, wildlife tours, or hiking trails to attract tourists that could bring revenue to the landowner as well as local businesses. One method to determine the potential for profiting from this type of venture would be to utilize the Travel Cost Method. The Travel Cost Method "is used to estimate economic use values associated with ecosystems or sites that are used for recreation" (Ecosystem Valuation, 2014). In this way, a landowner could determine an approximate price that a person might be willing to pay to visit their land and whether or not this option would be feasible to generate revenue.

For future research, a greater number of parcels and a larger sample area would be beneficial to make more reliable predictions of the actual changes that would occur based on *distance to the nearest wetland*. This would help define the level of bias for or against wetlands in the sample area. In addition, conducting biological surveys over an extended period of time would aid this research by not only defining the most common biological services present in my area of study, but also by identifying the value of each of those services. These biological surveys would include soil sampling, air and water quality testing, and cataloguing habitat and species richness.

Other future research could include utilizing the Contingent Valuation Method to determine the economic values of the biological services present on a parcel of land. This would entail sending surveys to local residents to ascertain the value they would place on the existence of these services. For example, would local residents be willing to pay an extra dollar a month on their electric bill to have the flood protection of nearby wetlands as opposed to cheaper electricity with an increased risk of flooding?

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Appendix

Table 1: Total Assessed Value

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.98
R Square	0.96
Adjusted R Square	0.96
Standard Error	62,436.79
Observations	102.00

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4.00	10,351,179,377,496.60	2,587,794,844,374.15	663.82	0.00
Residual	97.00	378,140,185,124.75	3,898,352,423.97		
Total	101.00	10,729,319,562,621.30			

Explanatory Variable	*Coefficients*	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	10,886.13	15,899.94	0.68	0.50	(20,670.85)	42,443.10	(20,670.85)	42,443.10
Distance to Nearest Wetland	3,038.31	3,554.90	0.85	0.39	(4,017.18)	10,093.80	(4,017.18)	10,093.80
Total Acres	5,731.11	116.98	48.99	0.00	5,498.94	5,963.28	5,498.94	5,963.28
Grassland Acres	(4,550.02)	900.56	(5.05)	0.00	(6,337.37)	(2,762.66)	(6,337.37)	(2,762.66)
Dryland Acres	(1,247.70)	273.11	(4.57)	0.00	(1,789.75)	(705.64)	(1,789.75)	(705.64)

Table 2: Total Real Sale Value

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.75
R Square	0.56
Adjusted R Square	0.44
Standard Error	347,881.13
Observations	24.00

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5.00	2,768,291,754,891.17	553,658,350,978.23	4.57	0.01
Residual	18.00	2,178,383,053,516.96	121,021,280,750.94		
Total	23.00	4,946,674,808,408.12			

Explanatory Variables	*Coefficients*	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	(3,371.71)	257,626.39	(0.01)	0.99	(544,624.67)	537,881.24	(544,624.67)	537,881.24
Total Acres	5,046.98	1,189.56	4.24	0.00	2,547.81	7,546.15	2,547.81	7,546.15
Distance to Nearest Wetland	40,168.58	64,755.96	0.62	0.54	(95,878.65)	176,215.81	(95,878.65)	176,215.81
Distance to Nearest Urban Environment	(7,067.44)	41,685.06	(0.17)	0.87	(94,644.50)	80,509.63	(94,644.50)	80,509.63
Dryland Acres	(1,968.43)	1,660.28	(1.19)	0.25	(5,456.55)	1,519.68	(5,456.55)	1,519.68
Grassland Acres	(11,524.64)	10,650.44	(1.08)	0.29	(33,900.39)	10,851.12	(33,900.39)	10,851.12

Table 3: Total Inferred Sale Value

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.98
R Square	0.96
Adjusted R Square	0.96
Standard Error	54,944.37
Observations	102.00

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4.00	8,015,953,422,165.79	2,003,988,355,541.45	663.82	0.00
Residual	97.00	292,831,761,386.41	3,018,884,138.00		
Total	101.00	8,308,785,183,552.20			

Column1	*Coefficients*	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	9,579.79	13,991.95	0.68	0.50	(18,190.35)	37,349.93	(18,190.35)	37,349.93
Distance to Nearest Wetland	2,673.71	3,128.31	0.85	0.39	(3,535.12)	8,882.55	(3,535.12)	8,882.55
Total Acres	5,043.38	102.94	48.99	0.00	4,839.07	5,247.68	4,839.07	5,247.68
Grassland Acres	(4,004.02)	792.49	(5.05)	0.00	(5,576.89)	(2,431.15)	(5,576.89)	(2,431.15)
Dryland Acres	(1,097.97)	240.34	(4.57)	0.00	(1,574.98)	(620.97)	(1,574.98)	(620.97)